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ABSTRACT

Developed by the Michigan State Board of Education, this document begins with brief discussions of a philosophy for the integration of computers into all content areas and district planning for computer use in schools. Essential goals and objectives for computer education are then outlined in the following areas: (1) computing and its evolving role in a technological society, including the historical development of the computer, the role and impact of computers in society, ethical and social issues raised by increased use of computers, and future trends; (2) computing fundamentals, including understanding of the basic operations, terminology, and parts of computer systems as well as the ability to independently operate a system; (3) computer applications, including familiarity with word processing, database management, spreadsheets, graphics, communications, and programming; and (4) computer-enhanced problem solving. A resource for district planning and a list of educational computer resources are appended. (MES)

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Essential Goals and Objectives for Computer Education

IR013266

Michigan State Board of Education

Spring 1987

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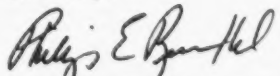
FOREWORD

Technology is a powerful driving force for educational change. Especially in the educational environment, we feel the profound impact of the increasing pace of technological development. Our curricula must reflect the belief that technological competence is fast becoming essential.

There is general acceptance that computer experiences, in particular, must be an integral part of K-12 education and that computer competence is a necessity for all students. The computer has the unique potential for enhancing learning and becoming a personal problem- solving tool for students.

The essential goals and objectives in this document provide direction for a comprehensive approach to computer education. I encourage you to use this document for developing, assessing, or revising your own computer education direction as you infuse the computer into content areas.

Sincerely,



Phillip E. Runkel
Superintendent of Public Instruction

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STATEMENT OF PURPOSE

Although there are many technologies available to schools today, the goals and objectives of this document emphasize one technology -- the computer. This document will assist administrators and teachers in planning, developing, implementing, and evaluating the use of computers in education.

Between 1983 and 1985, the number of computers in elementary and secondary U.S. schools quadrupled to more than 1,000,000 (The Johns Hopkins University's 1985 National Survey of Instructional Uses of School Computers). Simultaneously, the amount and quality of courseware in the content areas increased. The pervasiveness of hardware and software for educational purposes demands new and varied approaches to the use of computers in schools.

It is in response to this demand that the Essential Goals and Objectives for Computer Education were delineated. They provide a foundation for the use of computers in education and help build a philosophical base for integrating this technology into all content areas. This document, therefore, is an enabling instrument to be used as a resource by local administrators and teachers in constructing/revising the comprehensive school district curriculum.

It is not the intention of this document to define a separate curriculum area. Although these goals and objectives can be implemented through a computer class, it is suggested that they be integrated into the ongoing curriculum of the subject matter areas. Thus, they will be addressed in social studies, science, math, English, etc. Students who achieve these objectives within an integrated curriculum, or within a separate computer class, will have the skills required to be an effective citizen and worker in an information society.

Students who acquire the essential skills of computing referenced in this document will be prepared to continue their study of computers on an elective basis. Computer science courses in the secondary curriculum are natural extensions of these skills and focus on the computer as the object of instruction.

PHILOSOPHY

There is a dual need for schools to use technology in education. Schools are responsible for preparing students to function in the society in which they will live. Today, this means that students must learn about the roles of computers and other technologies which are prevalent in schools, homes, and the workplace. To become effective citizens of our information society, students need to acquire some basic knowledge about the computer, its appropriate applications, and its impact upon society. Schools also are responsible for providing effective and efficient means to improve learning. The computer is one means to improve learning for a variety of student populations. Preparation for the information society and learning enhancement are best served when technology is viewed as an integral part of curriculum and instruction.

The effectiveness of computers and other technologies in improving learning depends upon the ways in which they are used. Educators will need to match appropriate technologies to particular instructional tasks in all curriculum areas. This can improve those jobs which have always been done and allow undertaking tasks which previously were not feasible. Teachers at every level and in all subject areas should recognize and take advantage of the computer as a powerful and concrete device to develop thinking and problem solving skills that have real-life implications and uses.

The most effective learning experiences will be those structured so that the student controls the computer and the way in which information is handled. School districts should strive to provide appropriate hands-on experiences so that all students, regardless of their socioeconomic status, ethnicity, gender, or general level of academic achievement, can develop minimum computer knowledge and skills. Beyond that, educators need to employ the computer to augment classroom instruction, to better manage instruction, to develop new curricula and approaches to learning, and to present the computer as a personal tool for student learning.

DISTRICT PLANNING FOR COMPUTER USE IN EDUCATION

The need for computer education is evident. However, effective computer education can only be accomplished when a district planning process is adopted.

The planning process should begin with the development of a district's philosophy. The philosophy is a statement of the district's direction and commitment to the integration of computers into education. It is recommended that this statement be developed by a district-wide committee representing teachers, administrators, students, parents, and other community members. The philosophy should be adopted by the board of education and serve as the foundation for curriculum development related to the use of computers.

Once the philosophy has been adopted, the planning process should focus on establishing goals and a plan of operation. A plan of operation should provide details on how the district will address :

1. curriculum goals and objectives
2. staff development
3. computer access for students and staff
4. hardware
5. communication and public relations
6. personnel and support
7. software and support materials
8. evaluation

Issues and strategies for planning in these areas are included in Appendix A of this document. The appendix is an excerpt from The Process of District Planning, a comprehensive resource developed under a grant awarded by the Michigan State Board of Education.

INTRODUCTION OF ESSENTIAL GOALS AND OBJECTIVES

The following goals and objectives give the desired outcomes of computer education. They are derived from the presented philosophy and attempt to provide direction for computer integration. Four strands are defined:

- •Computing and Its Evolving Role in a Technological Society
- •Computing Fundamentals
- •Computer Applications
- •Computer-Enhanced Problem Solving

For each objective, a grade level range (K-3, 4-6, 7-9, or 10-12) is suggested for its introduction. The expectation is that the local school district curriculum plan will incorporate the development and reinforcement of these concepts and skills across subject areas and grade levels.

I. Computing and its Evolving Role in a Technological Society

Rationale:
Students need to be aware of the role of technology and its future impact on society, as well as their lives. As members of a society which utilizes technology and information processing, students also need to be cognizant of the social issues involved, their ethical obligations, and the legal responsibilities related to computer usage. By gaining a historical perspective, students will be able to identify trends in computing and formulate ideas about the future evolution and effect of the technology.

	Suggested Range for Grade Level Introduction
A. History of Computers and Computing	
Goal: To understand the historical development of the computer	
Objectives: The learner will	
1. identify some major historical computing devices	4-6
2. compare the different generations of computers and summarize their impact on society	7-9
3. evaluate the trends in computer development	7-9
B. Role and Impact	
Goal: To appreciate the role and impact of computers in society	
Objectives: The learner will	
1. describe ways in which the computer is used in the home, school, community, and workplace	K-3
2. describe computer-related careers	4-6
3. summarize those aspects of modern life that are possible because of the invention of the computer	4-6
4. evaluate the effect computers had on society and their influence on economic issues	7-9
5. identify other technologies that interact with the computer and recognize their uses (suggested, but not limited to: videodiscs, robotics, CAD/CAM systems, CD-ROM, and communication technologies)	7-9
6. identify special purpose devices and describe their unique capabilities (suggested, but not limited to: communication enhancement, adaptive devices, music synthesizers, speech synthesizers, and optical scanners)	7-9

	Suggested Range for Grade Level Introduction
C. Social Issues	
Goal: To understand the current and emerging ethical and social issues raised by the increased use of computers	
Objectives: The learner will	
1. discuss the implications of the copyright laws	4-6
2. identify possible effects of the illegal use of computers	7-9
3. discuss the pros and cons that exist regarding computers as they relate to the rights of the individual versus the Freedom of Information Act	10-12
4. assess the political issues that surround the use of computers	10-12
D. Futures Trends	
Goal: To formulate theories about the future evolution and effect of computers and other emerging technologies	
Objectives: The learner will	
1. identify possible changes in computers and other emerging technologies and recognize the possible impact on the home and workplace	7-9
2. identify and analyze how advances in computing and other technologies have increased the amount of information accessible to society (i.e. cable systems, telecommunications, networks, electronic mail, interactive video technologies, laser discs, online data bases, satellites)	10-12

II. Computing Fundamentals

Rationale:
This strand of Essential Goals and Objectives for Computer Education comprises skills and knowledge which permit the student, through actual use, to independently operate a computer system successfully. It is recommended that these basic skills be learned before more advanced topics and objectives are addressed.

A. Understanding Computer Systems

	Suggested Range for Grade Level Introduction
Goal: To understand the basic operation, terminology, and parts of computer systems	
Objectives: The learner will	
1. identify the major parts of a computer system	K-3
2. explain the functions of the major parts of a computer system	K-3
3. define and use appropriate computing terminology	K-3
4. identify selected peripheral devices for computer systems	K-3
5. describe the roles of hardware and software in computer operation	K-3
6. list some of the capabilities and limitations of computer systems	4-6
7. explain the role of computer programming in computer operation	4-6

B. Operating Computer Systems

Goal: To independently operate a computer system	
Objectives: The learner will	
1. demonstrate ability to begin and end a computer work session	K-3
2. demonstrate keyboarding skills	K-3
3. demonstrate proper care of computer hardware and software	K-3
4. operate a computer system using prepared software	K-3
5. analyze and correct routine problems encountered in hardware and software use	4-6
6. demonstrate use of essential system commands	4-6
7. demonstrate use of selected peripheral devices for a computer system	4-6
8. interpret the documentation to gain information about hardware and software products in use	7-9
9. evaluate software considering the content value and limitations	7-9

III. Computer Applications

Rationale:
Students need to use application software to understand how the computer can become a tool for solving problems. By becoming proficient in using word processing, data base management, and an electronic spreadsheet and familiar with computer graphics, communications software, and computer programming, a foundation will be built for enhancing problem solving skills.

	Suggested Range for Grade Level Introduction
A. Word Processing	
Goal: To understand the creation, modification, and display of text using word processing	
Objectives: The learner will	
1. enter text into the computer using a word processing program	K-3
2. edit the text entered	K-3
3. print the created document	K-3
4. store prepared data	4-6
5. load previously stored text into the computer	4-6
6. revise previously stored text	4-6
B. Data Base Management	
Goal: To understand the process of information management using a data base	
Objectives: The learner will	
1. retrieve information from an already developed data base	4-6
2. search the data base for specific information	4-6
3. analyze the information retrieved from a data base	4-6
4. print selected document(s)	4-6
5. design the input format and enter information into a data base	7-9
6. edit the contents of the data base	7-9
7. create a print format to display the data requested	7-9
8. analyze data for the purpose of developing, testing, and revising hypotheses	7-9

	Suggested Range for Grade Level Introduction
C. Electronic Spreadsheet	
Goal: To understand the process of numeric manipulation using an electronic spreadsheet	
Objectives: The learner will	
1. answer "What if?" questions and test hypotheses with an already created spreadsheet	7-9
2. design and enter numeric data, literal information, and formulas into a spreadsheet program	10-12
3. edit the contents of the electronic spreadsheet	10-12
4. analyze the results of executing formulas stored in the spreadsheet	10-12
5. change numeric data in specified cells and analyze the outcomes	10-12
6. store and retrieve the contents of the spreadsheet	10-12
7. control the content display of the spreadsheet	10-12
8. produce a hardcopy of all or selected portions of the electronic spreadsheet	10-12
D. Computer Graphics	
Goal: To become familiar with computer graphics	
Objective: The learner will:	
1. create a design using a prepared software package or a computer language	4-6
2. demonstrate use of peripheral devices in experimenting with various graphics techniques	4-6
3. create a graph or chart using a prepared software package	7-9
E. Computer Communications	
Goal: To become familiar with communications between two or more computers	
Objectives: The learner will	
1. explain the general purposes and several common uses of computer communications	7-9
2. identify the types of hardware and software required for computer communications	7-9

	Suggested Range for Grade Level Introduction
3. explain the general method of enabling two or more individuals using computers to communicate with each other	7-9
4. list activities made possible through the use of computer communications	7-9
5. indicate some of the safeguards which must be taken to protect society against misuse of computer communications	7-9

F. Computer Programming

Goal: To become familiar with programming in a computer language

Objectives: The learner will

1. develop skills in using basic elements and commands of a computer language such as Logo or BASIC	4-6
2. develop statements in a programming language which represent a step-by-step approach to a problem	7-9
3. enter the statements (program) into the computer	7-9
4. execute and debug the program as needed	7-9
5. validate the program by comparing the output with anticipated output	7-9

IV. Computer Enhanced Problem Solving

Rationale:
The computer can enhance the process of problem solving within the K-12 curriculum. Software designed to specifically develop problem solving skills can provide a foundation for application of these skills. The programs highlighted in the Computer Applications strand of this document are excellent tools to assist in applying these problem solving skills.

The development and application of problem solving skills using the computer are best accomplished when students work together. Computer interaction is most effective when human interaction is emphasized and encouraged.

A: The Computer as a Problem Solving Tool

	Suggested Range for Grade Level Introduction
Goal: To understand how computer-related tools can be used in the problem solving process	
Objectives: The student will	
1. develop problem solving skills using software designed for this purpose	K-3
2. determine an appropriate course of action and evaluate the results of the action when a problem is presented through a computer simulation	4-6
3. discuss the intended uses of the application programs referenced in the Computer Applications strand	7-9
4. describe a specified problem and determine an appropriate application package to use in solving the problem	7-9
5. solve a given problem using an appropriate application package	7-9
6. determine when an application package is appropriate to use and when a computer program must be written to solve a problem	10-12

APPENDIX A

Resource For District Planning

(excerpt from The Process of District Planning, a training module developed by Project TMT, School of Education, The University of Michigan, Ann Arbor, MI)

THE NEED FOR PLANNING

The complex process of district planning for microcomputers requires an integration of all facets of understanding about the use of computers in education. Technical knowledge of the microcomputer is not enough to accomplish the goals of planned change. Equally important is an understanding of the social and organizational aspects of the change process. Trainers need to reach key educators (teachers and administrators) in their districts to impart not only a technical understanding of computers (and the educational implications) but also, an understanding of the change process.

The planning process is not unique to computers. Due to the expense of the equipment, the technical nature of training requirements, and the need for teachers to incorporate new teaching methods as a result of the unique approaches inherent in some software, special planning for microcomputer use must be considered. A district plan should be synchronized with plans for use of other technology such as two-way video and community use of cable television.

A district-wide plan provides a comprehensive picture of microcomputer integration for a district. This picture provides the trainer, and computer coordinator, with a perspective that will allow them to set training goals to assist in the coordination of hardware and software purchase and use.

Research indicates that the most successful districts have a comprehensive and formal (written and approved) plan. Some school districts already have formal plans. In that case, this module may help in providing a different means for evaluating, for documenting the effectiveness of existing plans, or for documenting existing plans. Some trainers or district planners may want to adopt some of the various parts of the suggested plan in this module. They may also wish to obtain some of the references cited below and create another variation.

Other school districts do not have formal, written plans that have been adopted and are currently being followed. Still other school districts have partial plans, bits and pieces that are neither integrated nor comprehensive in nature.

In either case, it is suggested that a computer coordinator or trainer facilitate the creation of a comprehensive plan. Ideally, the computer coordinator and the trainer might train key educators in the district and participate in the formation of a committee to develop a plan. If a formal plan fails to materialize, then trainers may find it helpful to create a plan of their own to follow to provide some direction.

Three Types of Planning Questions

Research indicates that there are three basic types of questions that arise as districts deal with the use of computers: 1. technical, 2. policy, and 3. organizational.[1]

Fortunately, most questions of a technical nature usually have definite answers, such as: What kind of disks are needed for this brand of machine? Where should the machines be located? Will this program work on brand x computer? Will brand x printer work on brand y computer? These questions are easily answered.

Unfortunately, policy and organizational questions aren't so easily answered. Policy questions such as: Should programming classes be offered and to whom, and what languages should be taught? What schools should receive computers and for what purpose? There are organizational questions as well: Who should determine and how should they determine what software should be purchased? All of these questions require considerable thought.

It seems reasonable to conclude that a district must therefore consider a comprehensive formal plan that addresses all three levels. Because of the multi-faceted nature of computer planning, no single reference can be expected to bring about a complete picture. There are a number of excellent planning guides that a trainer might wish to acquire. These include: *Planning Guide . . . A District Computer Curriculum, Computer Applications Planning: A Guide to Planning and Implementing a District-Wide Program , Planning for Tomorrow's Schools: Problems and Solutions, Building a Quality Computer Educational Program: Resource Handbook.* (See the Reference section of this module for further information about these sources.)

General Issues In Planning

Before general issues are considered, there are several suggestions that can guide preliminary planning efforts. They are:

1. Start planning. It's never too late.

2. Consider multiple uses of hardware and software. Often the same computer(s) can be used in math instruction in the morning, and for English courses in the afternoon. The primary goal of computer utilization should be 100 percent use of the machine during school hours. Some districts, in order to facilitate use, have some computers on carts that can be wheeled from room to room. Sharing computers also involves trade-offs; multiple uses cause competition for scarce resources and create friction among staff.

3. Establish a committee planning process. Members may consist of:

   District and building level administrators
   Departmental and grade level teachers
   Librarians/media specialists
   Parents
   Students
   Business and industry leaders

4. Develop a financial plan. There are many hidden costs in microcomputer utilization. These costs are described in "Financial Planning Models" on page 15.

The Planning Cycle

There are as many possible ways to conduct the process of district planning as there are districts. No school district can follow an exact formula because each district must consider its own unique conditions. The literature, however, does show a definite pattern. The typical steps in district planning include:

1. Imagining: Creating an image of something to reach for in the near and distant future. What is possible?

2. Policy Analysis: What are our policies and how are they set? Who sets them?

3. Needs Assessment: Where are we presently? How much have we accomplished? What problems have we encountered?

4. Goal Setting: What are our goals? What do we need to overcome these problems, satisfy our needs, and meet or exceed our goals?

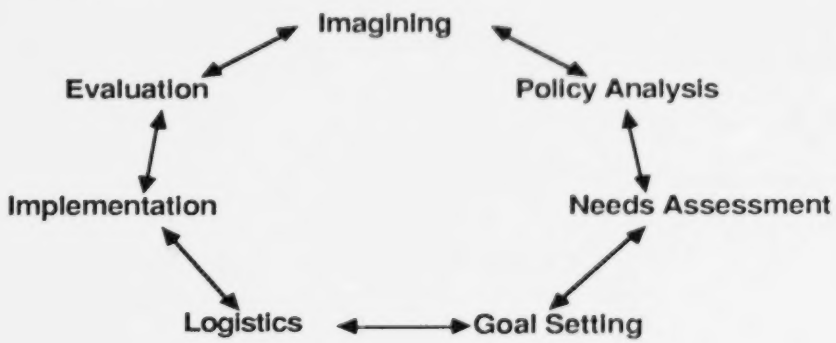
5. Logistics: Organizing and coordinating resources (equipment, key training personnel, teachers) to fulfill needs that will include planning for staff training expenditures on all activities including software and hardware.

6. Implementation: Carrying out a plan.

7. Evaluation: Monitoring implementation in view of the needs assessment and the district's plan and recommending changes.

District Planning is cyclical in nature. There is no time line defining the beginning or ending of planning. Planning is a continuous process. Even the best plans must be modified in order to adapt to continuous changes especially in the field of computers where change is so rapid. The typical district does not enter the process in a linear fashion. Many districts go directly to the planning phase with little regard for a planned direction or formal needs assessment. Even the best districts must stop from time to time (usually as part of the evaluation phase) to re-address their images, needs, and directions.

Therefore, the planning process is really a recursive cycle, with districts entering into the process at many different points.



The Planning Cycle

It is recursive in the sense that each step may require reworking the previous step. For example, in view of the needs assessment, the district planners re-think their image of the district's future. To clarify this cycle, many districts develop three-, four-, or five-year plans. In view of the accelerating changes in the microcomputer field, a three-year plan presently makes the most sense.

Imagining

The trainer not only must train the participants about what they presently need but must prepare them for the future. The United States is currently undergoing more rapid technological change than at any other time in our history.

There are additional issues that must also be addressed. A district that purchases out-dated equipment may not be getting a bargain. The increasing sophistication and decreasing costs of computers may cause the district to be caught with obsolete machines. Postponing the purchase of hardware, however, on the assumption that future costs will be lower penalizes students by slowing down training and development. There is a delicate balance to maintain. In order to meet the district's needs and goals, the best possible solution is not to delay purchase but to purchase the best available hardware that promises to offer the most use, for the longest projected usable life, with the lowest cost. Without an image of the future and a plan, however, districts tend to buy the most hardware they can, often disregarding training, software, maintenance, or other factors.

Policy analysis

Policy analysis in the context of change addresses: 1. climate of change, 2. policy context, and 3. the change process.[2]

It is important to note that trainers are in the best position to influence the setting of district-wide policies, to understand the staff development (training) needs, and to assess the present state of condition. It is important to consider outside assistance in these matters since outside experts can potentially give alternative perspectives.

Climate of change

There are two sources that motivate a district toward change: 1. external, and 2. internal.

External sources . These include local parent groups that seek to influence microcomputer use and its curriculum or work to obtain or donate hardware and software. Other external factors include state or federal mandates. Mandates are sometimes used to force the district into making a commitment. At present, the state of Michigan has no specific mandate for the use of computers, but suggested mandates such as recommendations from the National Commission on Excellence[3] exist. Still other external factors such as equipment or development grants from leading manufacturers (i.e., Tandy Corporation, Apple Educational Foundation, IBM Corporation) can influence change. Some districts interested in promoting changes seek out external sources for help.

Internal sources. The internal climate of change varies greatly from one district to another. Some districts seek to continuously change; other districts seek stability. Some districts have management styles that are problem-oriented; others have bureaucratic styles. Some districts seek out advice from staff; others do not. The trainer and the computer coordinator can support internal sources for change.

Policy context

Clearly stated policy is the product of a systematic process of choosing the right problems.[4] At this point, the trainer can be most useful. The trainer's responsibility is to train the district staff (teachers and support staff) to enable them to effectively plan and practice microcomputer use. It is only in actual practice that the district can discover what the real problems are.

A policy is a rule or guideline that reflects or directs the procedures, decisions, or actions of an organization and the individuals within it.[5] The trainers of a district may wish to consider the implications of training all the constituents of a district in their unique roles, and in the process of planning. A district that has trained staff who are aware of how to make changes and aware of how to plan for changes will probably show more change than districts without this skill. Policies can be affected by: preparing a presentation or report for the school board, preparing similar materials for the superintendent and the principals and, discussing this material with teachers and their representatives. The more a trainer succeeds in preparing participants in awareness of educational microcomputer possibilities and needs and in the planning process, the more likely the districts will be able to produce a cohesive plan.

The change process

The following is an example of a policy-making process:

1. The PIN (problem-issue-need) emerges. For example, a group of parents claim their children are not getting adequate computer education.

2. An analysis is conducted. A study is commissioned to assess the current situation and to project costs, staffing, and necessary rules and regulations for a range of options in providing for computer education.

3. The board discusses the elements of each option(s). For example, K-12 computer literacy issues and elementary school computer-assisted instruction (CAI) vs. high school job preparation program.

4. A draft policy covering the options(s) chosen is presented to the board for approval or revision. For example, the combination of the special education CAI program with upper elementary and junior high computer literacy program will be the mainstay of the computer education offering. However, each high school department will incorporate microcomputer technology as is appropriate.

5. A public review of policy is scheduled. Students, parents, teachers, and community at large are given an opportunity to present their views.

6. A decision is made to revise the draft policy. For example, in response to input the board decides to begin computer literacy earlier and to specify a strong link with local businesses and industry as part of the high school component.

7. The administration is charged with policy implementation and the evaluation of policy impact. For example, the administration through its curriculum and evaluation units carries out the implementation and evaluation of the computer education program.

The critical participants and their actions produce a viable policy for a district. These include:[6]

1. Administrative support and involvement
2. Staff participation (a direct reflection on how well informed or trained these people are)
3. Time lines and evaluation systems
4. Board and community involvement
5. Outside assistance

Administrative support and involvement is critical to the success of a program. Without administrative support, many districts will lack coordination and thus have an inefficient effort.

Staff participation by teachers and administrators is also critical. Since the teachers and students will be the users of the equipment, having them participate in the plan will result in better use of the equipment.

There is increasing support for obtaining community involvement in the planning process. Having board of education support can also mean commitment to the goals of the plan.

Outside assistance can come in the form of outside trainers or consultants. Training is also available from neighboring districts where the teacher or coordinator has experience with a particular type of training. Many universities, community colleges, intermediate school districts, and regional educational media centers have personnel who serve as trainers or consultants. Organizations such as MACUL, MECC, or ICCE have resources to contact.

When it is clear that policy will be set and the district has worked out who will set policy and who will have input, then the district can match the policies to their actions.

Needs assessment

Conducting a policy analysis sets the stage for a needs assessment. A needs assessment generally consists of reviewing facilities, personnel, and curriculum goals in terms of district policy. Others see the needs assessment as identifying the present status of the school system's plan. Some interpret needs assessment as developing a position paper that consists of:[7]

1. Introduction
2. National and regional outlook
3. Description and analysis of problems in the school district (if any)
4. Benefits to the community from the expanding computer education program
5. Explanation (or exploration) of versatility and multiplicity of use
6. Financial and human resources available: local, federal, state, businesses, universities
7. Ways to coordinate computer education
8. How to use teachers as a primary resource
9. Budget options
10. Suggested major policy adoptions
11. Outline of a four-year plan.

The forward look (into planning) and the recursive look (back to policy adoptions) are both present in the above sample position paper outline.

Goal setting

With a clear policy and an understanding of the district's needs, the task of setting goals for the district is made easier. The recursive nature of the planning process is once again revealed, demonstrating that it is impossible to realize all goals. Goals must be compromised because of budget considerations, hardware, software, training, and other factors. Since educators are familiar with setting clear goals, the process will not be presented in detail. A good reference for goal setting is *Preparing Performance Objectives* by Robert F. Mager, 1976.

The Content of Goals

Computer Literacy. A compelling argument favoring a computer literacy concept is the need for children to prepare for the information revolution. The software, however, continues to increase in sophistication. Computer scientists initially required users to adapt to complicated-to-use software. The slightest mistake created all sorts of problems. Presently, the trend is to require the computer to adapt to the user, thus making software easier to use. If this trend continues, and there is every reason to believe that it will, then there will be no need for computer literacy (in this context). That is to say that computer literacy would make no more sense than car literacy (as contrasted to driver education), calculator literacy, or phone literacy.

The driver education analogy is a good example of what might be interpreted as computer literacy. In driver education, students are taught: 1. the very basic mechanics of care (i.e., keeping the car in good repair, and changing a flat tire); 2. the rules and regulations of the law; and 3. common courtesy and safe driving practice. Translating this into "computer literacy," one might consider: 1. basic hardware knowledge (i.e., keeping the computer running properly in terms of temperature); 2. the ethical and legal aspects (i.e., right of privacy of data, and issues of copyright); and 3. common courtesy when working on the computer. In this context, driver education is a small component of a school's curriculum. This issue is addressed in detail in the *Computers in the Curriculum* module.

FACTORS TO CONSIDER IN PLANNING

There are a number of interrelated factors that must be considered when planning. The major dimensions focus on two issues: 1. activities, and 2. components. Each of these two major dimensions has a number of sublevels. Activities has three major sublevels: A) Teaching and Learning Activities, B) Supplemental Instruction, and C) Administrative Activities. The eight major components of activities are: A) Curricula, B) Staff Development, C) Student/Staff Usage, D) Software and Support Material, E) Hardware and Facilities, F) Communication and Public Relations, G) Personnel and Support, and H) Evaluation. The interaction of these two dimensions (activities versus components) produce twenty-one separate topics to consider in a comprehensive plan. (See Master No. 1)

Teaching and Learning Activities with Computers

The use of the computer to deliver instruction or to support an English class through the use of word processing software as a "tool" may be part of what a district calls computer literacy. Whether or not it is useful to use the term (and imply a goal of literacy) should be debated by the district. What is clear is that learning and teaching activities are taking place that involve the use of a computer.[5]

There are two popular and similar conceptual models of teaching and learning activities. One is by David Moursund[5] who has developed a model in which the teaching and learning activities focus on:

1. About Computers
2. The Use of Computers
3. The Integration of Computers as a Tool

Moursund argues that as computer use in the schools is better understood, the focus shifts from "about computers" to "use of computers" to "complete integration." This technological penetration of life is similar to what has happened in the past with the refrigerator, telephone, or television.

About Computers. Some schools teach the history of the computer, an understanding of hardware, and the fundamentals of programming so students can better understand the use and societal importance of computers.

Use of Computers. In some learning activities, the teaching is done by computer (instructional delivery). These activities are sometimes drill and practice to enhance the teaching of objectives. Sometimes, the computer teaches new material (enrichment) or provides an alternative way of teaching (remediation).

Integration as a Tool. This explores the use of the computer as a tool to do work, such as word processing. The students are taught how to use the computer but are not graded or assessed on how they have learned word processing. The entire focus of the course is on the writing process, not the tools of use.

The second conceptual model by Robert Taylor[6] focuses more on the computer itself acting in the role of: 1. Tutor; 2. Tool; and 3. Tutee.

Tutor. This is similar to Moursund's use of computers in teaching concepts. The computer acts as the tutor to teach the student.

Tool. The use of a tool, such as an application like word processing, is an example of tool use.

Tutee. This concept is quite different from any of Moursund's concepts. Logo, when used in a microworld environment, is an example of the computer acting as a tutee. This means that the student teaches or constructs the microworld on the computer. The student hypothesizes and explores the microworld, thereby learning in the process. There are other conceptual models that may be suitable for a district. Certainly, these two models will undergo changes as the hardware and software improves. Each district must decide what uses they will make of the computer as a multi-purpose tool. They must decide what value they place on the various types of teaching and learning activities regarding computers. One district may decide to focus on the integration as a tool concept and cover learning about the computer in the process of its use. Another district may decide to create microworlds[7] for students and in the process use them for instruction and for learning about computers. Still others may wish to balance their activities while attempting to use the computer in a variety of ways and purposes.

Supplemental Instructional Activities

Supplemental instruction refers to the use of the computer to manage instructional activities and to provide support in the use of teacher utilities. Worksheets, test generators, graphics packages, and puzzles are all examples of supplemental instructional activities. These activities are sometimes used to

promote the use of computers. Many teachers have acquired an interest in educational computer applications in education through their use of supplemental instruction. In fact, some districts purchase a special computer for teacher-access only so that teachers may use it exclusively for supplemental instruction activities.

Administrative Activities

The computer has historically been an important administrative tool dating back to mainframe use. Now the microcomputer is taking over some of these functions and is fulfilling new or unique functions.

A more detailed explanation of administrative uses is offered in the *Administrative Uses* module. Administrative uses include such activities as class scheduling, attendance and student and teacher databases, such as student test data, teacher payroll, and teacher performance. The district may also send personalized letters home to parents using a mail-merging utility.

The administrative uses category is not always included in the instructional computing budget; however, there are times when it may be convenient. It is included in this example because of the need for staff development (training) and in purchasing the same type of equipment for the instructional activities (this may not always be possible).

Major Components of Activities

The district must address its needs in an organized manner. Care in crafting must be foremost in order to produce a set of policies that is agreeable to the teachers, students, and community. The following eight issues are the major components that specify a particular type of usage.

Curricular Issues. These issues deal with the types of uses the computer has in the curriculum and in which courses they should be used. These issues are important enough to drive the entire planning process. Given a clear policy, a set of goals must be directed toward focusing on the curricular issues in carrying out the policies. Curricular issues that involve questions about programming are referenced in the *Computers in the Curriculum* module.

Staff Development. For districts that are just beginning to implement microcomputers on a large scale, a great deal of staff development in the promotion of computer use is needed. For districts already heavily involved in computers, staff development does not have to concentrate as much on getting teachers involved as it does on promoting appropriate uses. Training issues are referenced in the *Training Methods* module.

Student/Staff Usage. With the curriculum set, planning about student/teacher usage patterns is necessary. This calls for creative planning. Care must be taken to consider equitable distribution of computers for the three types of usage. Distributions within student usage needing to be considered are such dimensions as: grade level, regular and special education, gender, ethnicity, and subject matter. Staff usage should be considered as that used by teachers, administrators, or paraprofessionals. This type of usage is particularly important for the non-teaching and learning activities, such as instructional management and administration. These fields overlap; a teacher who uses a computer in his or her classroom for teaching purposes may also use it for instructional management purposes. Some districts might even share a computer with the principal's office.

Many believe that students should have a one student to one microcomputer ratio. In fact, many activities (including programming) can have ratios of two or three students per computer. There are many creative ways of using one computer for a whole class.

Hardware. Once student and teacher usage is known, the demand upon existing equipment and additional or new equipment can be calculated. Equipment considerations should also deal with peripherals such as special input devices (i.e., joystick, light pen, graphics pad, and mouse) and output devices (i.e., printers, voice synthesizers, and turtles). Planning for maintenance is also critical. The acquisition of new hardware cannot be made without considering the types and quantity of software. Districts should consult local vendors and other purchasing agents, such as regional educational media centers, for possible discounts in purchase. Additional costs should be considered to allow for paper and ribbon supplies. Depending on the type of use, students may need to have individual floppy disks; therefore, purchase of disks is also an important consideration.

The facilities where computers are located are important. Protection from excessive heat, cold, and moisture, and security from theft and damage are major concerns. Some districts, however, become so overly concerned about these issues that they impede educational goals by requiring such elaborate security procedures that they discourage use.

There are three types of placements for computers:

1. Laboratory. A group of computers placed in one location offers a secure place for equipment and requires less supervision and staff training. They are dependent on a small but well-trained staff, which can present scheduling problems. Sometimes certain staff can dominate the use of computers.

2. Transportable Systems. These are computers on carts that are shared by all the teachers and students. This allows maximum flexibility but presents the greatest problem for security. Movable equipment is difficult to maintain and to monitor.

3. Classroom. Use in the classroom usually means that the district must purchase many computers. It is difficult (not impossible) to make good instructional use of one computer for a class size of thirty. It is, however, also the best placement to increase teacher knowledge, experience, and involvement.

Communication and Public Relations. Communication takes place at many levels (district to building, district to community, and building to teachers, teachers to students, building to community). It is important to plan for meaningful two-way communication at all levels. The importance of teacher-to-teacher communication should not be underestimated. Teacher support networks can be extremely important in helping fellow teachers master use of the computer. It is especially important for communication to enhance public relations. In fact, much of the success in the implementation of a district plan depends on effective communication.[9]

Personnel and Support. Many successful districts often employ a computer coordinator. In general, the computer coordinator is a person in charge of the coordination and implementation of a district plan. In small districts, this role might be delegated to a teacher on a part-time or overflow workload basis. Larger districts often employ a coordinator full-time. The coordinator may also sometimes be the trainer. Other support personnel may consist of trainers and technical support people to handle minor technical difficulties and to set up new equipment.

Software. Software is often overlooked when considering a district-wide plan. Many goals may not be accomplished if an adequate amount of good quality software cannot be found. *The Process of Software Evaluation* module deals with software issues in detail. Back-up policies for software and documentation are important considerations. Also important are policy decisions regarding who in the district should handle purchasing considerations (committee, individual teacher, etc.).

Evaluation. Evaluation components are often overlooked. Three areas need to be addressed: what will be evaluated, when to evaluate, and who will do the evaluation.

Key Planning Issues

The interaction of the two dimensions, usage (with three levels) and the eight levels of component activities, comprise twenty-one separate, but overlapping topics to consider. The POAR (Problem, Objective(s), Activities, Resource(s)) model [9] can now be applied to the planning model. This application of the model accommodates the fact that the dimensions overlap. The factors of the POAR model are:

Problem: A concise statement of a particular problem directly related to specific activities and components.

Objective(s): Objectives that are set to counter the problems.

Activities: Actions taken to complete the objectives.

Resource(s): The human resources necessary to complete the actions. This includes staff such as coordinators, trainers, administrators, and aides. Another important aspect is the required financial resources.

Masters No. 11 and No. 12 are examples of Problem Analysis Worksheets. There are more problems that a district may encounter. The following problem statements represent a sample of problems; each district may have more or different problems.

Sample District Problem Statements

1. A programming course requires microcomputers with adequate power and memory.
2. The district has a number of different computers, some are not in use.
3. The district wishes to purchase special hardware and software to assist in teaching computer literacy.
4. The district cannot decide on the scope or sequence of programming languages and whether or not programming should be required of all students.
5. Staff is unfamiliar with the latest developments in CAD/CAM and robotics, even though the school calls for a course on this topic.
6. Many teachers and students have little keyboarding skills.
7. Many good teachers leave teaching to take better paying jobs in the computer industry.
8. Teachers are not even aware of how fast the computer industry and the educational computing market are changing.
9. Local businesses complain that the students graduating from high school do not have the word and data processing skills they would like.
10. Some software does not run on existing equipment.
11. Some important software gets "blown" (rendered unusable), and class progress is hindered.

12. Parents complain that students are not getting enough exposure to computers.
13. Many teachers want to use the computer but feel that they do not have the training and that certain departments or teachers dominate what equipment they have.

Financial Planning Models

Moursund[10] has suggested that two percent of a district's overall funding level be expended on instructional computing. This figure is a suggested starting point and is an example of what a typical college might spend; individual districts may arrive at a very different figure. There are many hidden costs in financial plans for microcomputers. Only by having a comprehensive plan, can districts estimate all costs.

The following example is an adaptation of Moursund's plan in view of the TMT activities and components model for a district with 5,000 students and an annual budget of $12.5 million ($2,500 per student).

Two percent of $12.5 million yields a budget of $250,000 for an instructional computer budget (ICB).

Sample ICB Budget

Component	%ICB	Total Dollars	Dollars Per Pupil
1. Curricula	2	5,000	1.00
2. Staff Development	8	20,000	4.00
3. Student/Staff Usage	--	–	–
4. Software & Materials	17	42,500	8.50
5. Hardware	50	125,000	25.00
6. Communication & P.R.	2	5,000	1.00
7. Personnel & Support	17	42,500	8.50
8. Evaluation	4	10,000	2.00
Total	100	250,000	50.00

Assuming a district spends $1,000 per machine, they will be able to purchase 125 machines. In the first year they would have a ratio of about one machine per 40 students. (The average in the United States in 1984 was 1:120.)

Spending patterns may be different depending on existing hardware and resources and curriculum emphasis. In subsequent years, the spending pattern may change by decreasing acquisitions of new hardware and increasing software, staff development, and other expenditures.

The Sequence of Planning

There is no definite sequence to planning; however, the following sequence is one suggested way. Some districts may prefer to sequence the component planning in other ways.

1. Policy analysis and needs assessment are completed by a position paper. The board of education in cooperation with the teachers, students, and community drafts and accepts a policy.

2. A subcommittee reviews the curriculum and recommends a series of proposals.

3. General curriculum goals are stated.

4. Staff development (training) is planned to update teachers on important software, its use in relation to the general curriculum, and to provide important information for teachers to further develop specific curricula.

5. The student/staff usage pattern is reviewed to satisfy equity policies and insure the most efficient use of the computers in consideration with all other possible uses.

6. Software is located, reviewed, and evaluated for possible purchase and use.

7. Hardware use is reviewed to ensure that an adequate amount is available and properly configured.

8. Communications to teachers about curriculum and other new developments are provided. This information can be communicated to the community through public announcements.

9. Support given this curriculum is in the form of specific training and continuous technical support for the software being used.

10. Evaluation is planned in advance of the implementation. There are many different ways to evaluate plans and their implementation.[11] Some districts often seek an outside evaluator from private, college, or university sources.

11. All of the above activities are evaluated in terms of human and financial resources. Often, if the budget is limited, plans may need to be redeveloped.

Implementation

The district must be prepared to carry out its plan. Research determines that there are three basic strategies:

Reason: This strategy assumes that the implementation of change can be brought about by appealing to the teacher's sense of logic and reason, showing them a rational plan and supporting research.

Power: A power strategy is usually top-down. Administration requires a certain policy to be carried out and enforces it. This plan does not always elicit cooperation from all teachers.

Influence: This strategy is to persuade the teachers of the importance of computers. Often a skilled trainer or coordinator can appeal to the teachers to get them involved. The recommendations in this module to involve the teacher, students, and the community in setting the policy and plans for the district are an attempt to influence their cooperation. Different sorts of people respond to different strategies. Most implementation strategies probably use some combination.

Staff development includes not only the rational training process but also a socialization process. The training becomes a part of a re-socialization process to allow the group to participate and anticipate changes in the curriculum brought about by the use of this technology. This also includes support groups.

Evaluation

Many districts often make the mistake of not planning for or carrying out an evaluation. Evaluation can be done by self-examination or by an outside source. Outside evaluation sources might include consultants from a university or college, or from an ISD or REMC.

There are many evaluation models that can be followed.[11] It is important to look at each step outlined in the plan and evaluate its effectiveness in teaching or administering educational programs.

Summary

The district planning process has had a long and involved history before the microcomputer revolution. The computer is rapidly becoming an important part of American society, but there is little precedence to follow in planning for its use in the schools. Its specific role has not as yet been determined; districts must identify for themselves the most important aspects. The computer, the training, and all other aspects of its use are still relatively expensive. Therefore, there is a compelling reason to develop a comprehensive plan that will allow a district to have a positive educational impact on its students. After all, that is the single most important objective. It can be realized only if teachers and staff are trained to be aware of the educational potential and social importance of the computer.

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Glenn Fisher, *Building a Quality Computer Educational Program. Resource Handbook*, Bureau of Education and Research, 1984, Paso Robles, CA 93446.

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APPENDIX B

Educational Computer Resources

EDUCATIONAL COMPUTER RESOURCES

CLASSROOM COMPUTER LEARNING. Emphasis is on new ideas for curriculum planning, system development, and creative computing. Published by A. Peter Li, Inc., 2451 E. River Rd., Dayton, OH 45439.

COMPUTERS IN THE SCHOOLS. Published quarterly at the Haworth Press, Inc., 75 Griswold Street, Binghamton, NY 13904.

COMPUTING TEACHER, THE. Designed for educators interested in the instructional uses of computers and calculators. Published by the International Council for Computers in Education (ICCE), University of Oregon, 1787 Agate Street, Eugene, OR 97403 and available to members of ICCE.

CUE NEWSLETTER. Published six times during the year by Computer-Using Educators, Inc., P.O. Box 2087, Menlo Park, CA 94026 and available to members of CUE.

EDUCATIONAL TECHNOLOGY. Published by Educational Technology Publications, 140 Sylvan Ave., Englewood Cliffs, NJ 07632.

ELECTRONIC EDUCATION. A publication designed for K-12 educators who are interested in applications of technology into the classroom. Published by Electronic Communications, Inc., Suite 220, 1311 Executive Center Drive, Tallahassee, FL 32301.

EDUCATIONAL LEADERSHIP. Published by ASCD, 125 N. West St., Alexandria, VA 22314.

ELECTRONIC LEARNING. A magazine that provides comprehensive and practical information about developments in computer education. Published by Scholastic Inc., 730 Broadway, New York, NY 10003-9538.

MACUL (Michigan Association for Computer Users in Learning) NEWSLETTER. Published by MACUL, P.O. 628, Westland, MI 48185 and available to members of the association.

MEDIA SPECTRUM. Published quarterly by Michigan Association for Media in Education (MAME), University of Michigan, Bureau of School Services, 3338 School of Education Building, Ann Arbor, MI 48109.

TEACHING AND COMPUTERS. A monthly magazine for today's elementary classrooms published by Scholastic, Inc., P.O. Box 2040, Mahopac, NY 10541.

T.H.E. JOURNAL - TECHNOLOGICAL HORIZONS IN EDUCATION. Published by Information Synergy, Inc., 2626 S. Pullman, Santa Ana, CA 92705.

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